

THE GENERATION OF NUCLEI OF COSMIC RAYS OF
SOLAR ORIGIN

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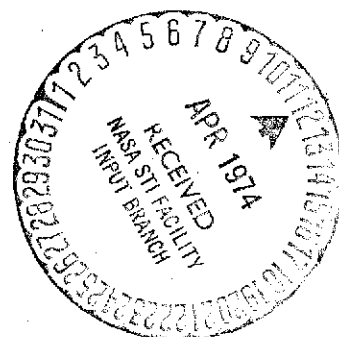
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16. Abstract A brief treatment of some observations of solar activity and heavy nuclei believed to be of solar origin and observed during the flights of the "Elektron" series satellites. There is some discussion of the possibility that the two previously mentioned phenomena are coincidental and an example arguing in favor of the opposite view, i.e., that there is no particular basis for linking the two.			
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Observations of fluxes of nuclei of primary cosmic rays, made throughout /2446* the course of a number of years on satellites, have made it possible to record instances of increases in such fluxes which can be interpreted as flares related to the acceleration of nuclei on the Sun. Both long term increases in the nuclei fluxes and instances of short term increases have been observed [1]. The characteristic peculiarity of a number of cases was a predominant increase in fluxes of the heavier nuclei, which could be explained by the predominant acceleration of such nuclei on the Sun [1].

In [1, 2] there are reports of certain cases of increases in nuclei fluxes recorded during the flights of the "Elektron-2" and "Elektron-4" satellites. This report contains data on 8 instances of a short term increase in a flux of nuclei having a charge $Z > 20$, which was observed during the flight of the "Elektron-4" satellite. In these cases the recorded time of counting increased more than about 5 times over a time interval of 16-18 minutes. This signified recording of 5 nuclei over the indicated time interval at an average counting rate of 0.034 min^{-1} , under measurement conditions in which a counter having low relative aperture was used ($G \approx 30 \text{ cm}^2 \cdot \text{ster}$).

A statistical analysis was made to estimate the possibility of explaining the increases in the counting rate by statistical deviations. It was found that the probability of recording 8 such instances does not exceed $5 \cdot 10^{-4}$. This shows that all these cases cannot be explained by statistical fluctuations. At any rate, part of them are linked, consequently, with a genuine increase in the flux of nuclei. However, in all cases there was no recorded increase in

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*Numbers in the margin indicate pagination in the foreign text.

intensity of nuclei with $Z \geq 2$ and $Z \geq 5$ which was more than 15 to 20%. Hence, one can only mention the predominant increase in the flux of nuclei with $Z < 20$. In the table, data are cited on the short term cases of increase in the rate of counting nuclei with $Z > 20$ (period from July 1964 through January 1965): the duration of increase, the relationship of rate of counting at time of increase to mean rate of counting (η), excess flux of nuclei with $Z > 20$ (ΔN), accompanying phenomena on the Sun, and time of recognition of increases in the flux of nuclei relative to these phenomena (Δt). One can see that half of the cited cases are accompanied by various manifestations of solar activity. All cases accompanied by solar phenomena are attributed to November 1964. According to the data on solar activity [3] throughout the course of November 1964, nearly 100 various phenomena were recorded, such as solar flares, ejection of the solar matter, eruptive protuberances, etc., whose time of appearance is known with accuracy to the minute. Recognition of cases of increase in the counting rate of nuclei with respect to phenomena on the Sun comprised from about 20 minutes to one hour. One can estimate the number of cases of coincidences of solar phenomena with recording increases in the counting rate of nuclei. If one accepts the longest recognition time (about one hour) for the "resolving time", one could expect the appearance of approximately one random coincidence. This estimate indicates the wisdom in linking the recorded bursts of the flux of nuclei to the solar phenomena. On the other hand, it is possible that one can have an increase in the flux of nuclei without a determining link with solar phenomena. Thus, for example, in the same flight of the "Elektron-4" satellite, 3 November 1964, 21 hours 39 minutes UT, there was a flash having an intensity of nuclei with $Z > 20$, 3.5 hours in duration and adequately reliably supported statistically. At moderate (recordable) intensity of nuclei, in 3.5 hours one could expect the influx of 8 nuclei, while 28 nuclei were observed. The probability that this event was caused by statistical fluctuation is $\leq 10^{-6}$. Even if one used the mean value of counting rate over the whole orbit, including the flare (0.056 min^{-1}), the probability of appearance of 28 nuclei in 3.5 hours as the result of statistical fluctuation is equal to $5.6 \cdot 10^{-5}$. Hence, in the given case an increase in the counting rate of nuclei with $Z > 20$ was observed which was clearly not of a statistical character. However, the natural appearance of solar activity throughout the course of the indicate time interval

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was a radio flare, type 3, at a frequency of [Translator's Note: blurred word] 8 MHz with a duration of about 2 minutes recorded at the end of the flare [Translator's Note: blurred word] (4.XI, 01 hours 03 minutes UT).

Hence, apparently, the appearance of solar activity is not always a mandatory prerequisite for the appearance of conditions necessary for the acceleration of nuclei on the Sun.

Date and time, beginning of instance, UT	Duration minutes	η	$\Delta N, m^{-2} \cdot sec^{-1} \cdot stere^{-1}$	Coincidental phenomena on the Sun	$\Delta[T.N.: blurred] min$
4.VIII 1964 6 hrs 48 min	16	10	1.6 ± 0.8	-	-
3.IX 1964 24 hrs 34 min	18	5	1.2 ± 0.7	-	-
9.IX 1964 23 hrs 54 min	16	7	1.5 ± 0.8	Bite eruption of matter 23 hours 14 minutes	40
11.XI 1964 14 hrs 46 min	16	7	1.5 ± 0.8	Appearance of active filament 14 hours 15 min	31
14.XI 1964 08 hrs 42 min	18	5	1.2 ± 0.7	Solar flare -1, dark eruptions 08 hours 20 minutes, 08 hours 10 minutes	22-32
20.XI 1964 03 hrs 26 min	16	4	1.3 ± 0.8	Solar flare -1, 02 hrs 23 min	63
8.XII 1964	18	5	1.2 ± 0.7	-	-
29.I 1964 01 hr 07 min	18	5	1.2 ± 0.7	-	-

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